

# About Your Snap Circuits Parts

(Part designs are subject to change without notice).

**Note:** If you have the more advanced Models SC-300, SC-500, or SC-750, there is additional information in your other project manual(s).

The **base grid** functions like the printed circuit boards found in most electronic products. It is a platform for mounting parts and wires (though the wires are usually "printed" on the board).

The blue **snap wires** are just wires used to connect other components, they are used to transport electricity and do not affect circuit performance. They come in different lengths to allow orderly arrangement of connections on the base grid.

The red and black **jumper wires** make flexible connections for times when using the snap wires would be difficult. They also are used to make connections off the base grid (like the projects using water).

The **batteries (B1)** produce an electrical voltage using a chemical reaction. This "voltage" can be thought of as electrical pressure, pushing electrical "current" through a circuit. This voltage is much lower and much safer than that used in your house wiring. Using more batteries increases the "pressure" and so more electricity flows.

The **slide switch (S1)** connects (ON) or disconnects (OFF) the wires in a circuit. When ON it has no effect on circuit performance.

The **press switch (S2)** connects (pressed) or disconnects (not pressed) the wires in a circuit, just like the slide switch does.

Resistors, such as the **100Ω resistor (R1)**, "resist" the flow of electricity and are used to control or limit the electricity in a circuit. Increasing circuit resistance reduces the flow of electricity.

The **photoresistor (RP)** is a light-sensitive resistor, its value changes from nearly infinite in total darkness to about 1000Ω when a bright light shines on it.

A light bulb, such as in the **2.5V lamp (L1)**, contains a special wire that glows bright when a large electric current passes through it. Voltages above the bulb's rating can burn out the wire.

The **motor (M1)** converts electricity into mechanical motion. Electricity is closely related to magnetism, and an electric current flowing in a wire has a magnetic field similar to that of a very, very tiny magnet. Inside the motor is three coils of wire with many loops. If a large electric current flows through the loops, the magnetic effects become concentrated enough to move the coils. The motor has a magnet inside so, as the electricity moves the coils to align them with the permanent magnet, the shaft spins.

The **speaker (SP)** converts electricity into sound. It does this by using the energy of a changing electrical signal to create mechanical vibrations (using

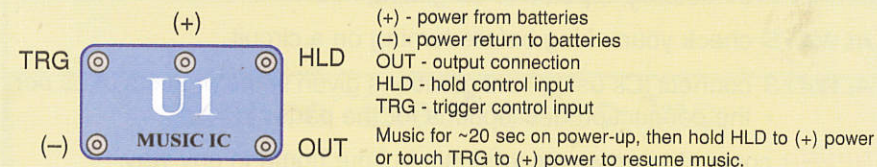
a coil and magnet similar to that in the motor), these vibrations create variations in air pressure which travel across the room. You "hear" sound when your ears feel these air pressure variations.

The **whistle chip (WC)** contains two thin plates. When an electrical signal is applied across them they will stretch slightly in an effort to separate (like two magnets opposing each other), when the signal is removed they come back together. If the electrical signal applied across them is changing quickly, then the plates will vibrate. These vibrations create variations in air pressure that your ears feel just like sound from a speaker.

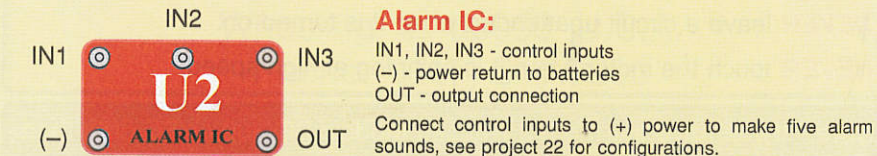
The **LED (D1)** is a light emitting diode, and may be thought of as a special one-way light bulb. In the "forward" direction (indicated by the "arrow" in the symbol) electricity flows if the voltage exceeds a turn-on threshold (about 1.5V); brightness then increases. A high current will burn out the LED, so the current must be limited by other components in the circuit. LEDs block electricity in the "reverse" direction.

Some types of electronic components can be super-miniaturized, allowing many thousands of parts to fit into an area smaller than your fingernail. These "integrated circuits" (ICs) are used in everything from simple electronic toys to the most advanced computers. The music, alarm, and space war ICs (U1, U2, and U3) in Snap Circuits are actually modules containing specialized sound-generation ICs and other supporting components (resistors, capacitors, and transistors) that are always needed with them. This was done to simplify the connections you need to make to use them. The descriptions for these modules are given here for those interested, see the projects for connection examples:

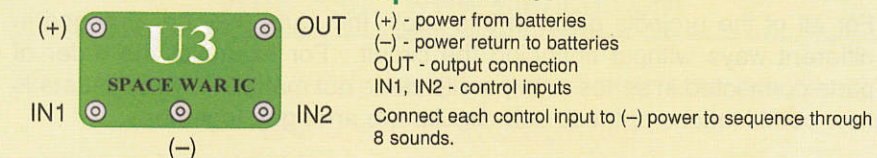
## Music IC:



## Alarm IC:



## Space War IC:





## DO's and DON'Ts of Building Circuits

After building the circuits given in this booklet, you may wish to experiment on your own. Use the projects in this booklet as a guide, as many important design concepts are introduced throughout them. Every circuit will include a power source (the batteries), a resistance (which might be a resistor, lamp, motor, integrated circuit, etc.), and wiring paths between them and back. **You must be careful not to create "short circuits"** (very low-resistance paths across the batteries, see examples below) as this will **damage components** and/or **quickly drain your batteries**. Only connect the ICs using configurations given in the projects, incorrectly doing so may damage them. **Elenco™ Electronics is not responsible for parts damaged due to incorrect wiring.**

### Here are some important guidelines:

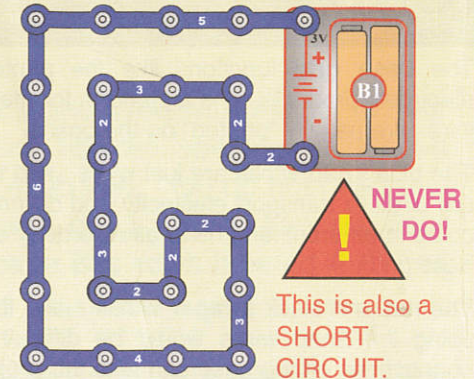
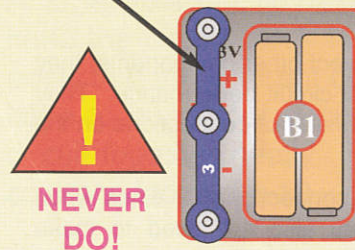
- ALWAYS** use eye protection when experimenting on your own.
- ALWAYS** include at least one component that will limit the current through a circuit, such as the speaker, lamp, whistle chip, ICs (which must be connected properly), motor, photoresistor, or resistor.
- ALWAYS** use the LED and switches in conjunction with other components that will limit the current through them. Failure to do so will create a short circuit and/or damage those parts.
- ALWAYS** disconnect your batteries immediately and check your wiring if something appears to be getting hot.
- ALWAYS** check your wiring before turning on a circuit.
- ALWAYS** connect ICs using configurations given in the projects or as per the connection descriptions for the parts.
- NEVER** connect to an electrical outlet in your home in any way.
- NEVER** leave a circuit unattended when it is turned on.
- NEVER** touch the motor when it is spinning at high speed.

**Note:** If you have the more advanced Models SC-300 or SC-500, there are additional guidelines in your other project manual(s).

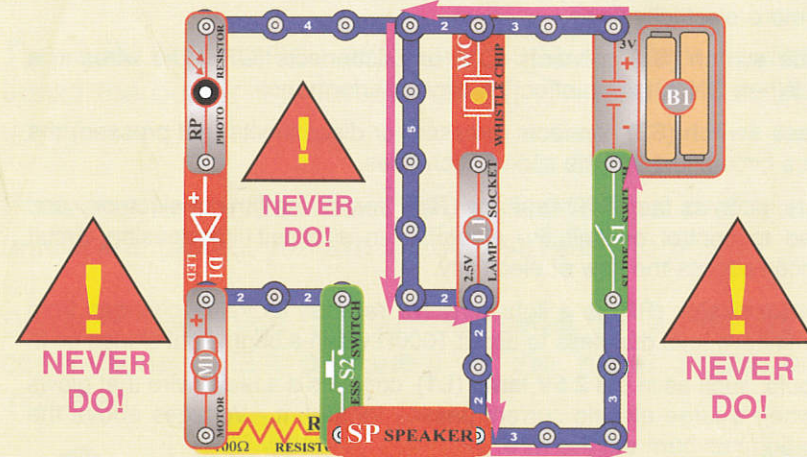
For all of the projects given in this book, the parts may be arranged in different ways without changing the circuit. For example, the order of parts connected in series or in parallel does not matter — what matters is how combinations of these sub-circuits are arranged together.

### Examples of SHORT CIRCUITS - NEVER DO THESE!!!

Placing a 3-snap wire directly across the batteries is a **SHORT CIRCUIT**.



When the switch (S1) is turned on, this large circuit has a **SHORT CIRCUIT** path (as shown by the arrows). The short circuit prevents any other portions of the circuit from ever working.



You are encouraged to tell us about new circuits you create. Upon review, we will post them with your name, age, and hometown in a special section on our website. If we use them in future manual revisions, we will send you a copy of the manual so you can show your family and friends. Send your suggestions to Elenco™ Electronics.

**WARNING: SHOCK HAZARD** - Never connect snap circuits to the electrical outlets in your home in any way!



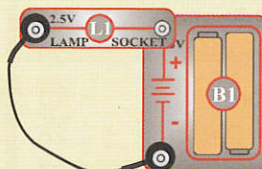
## Advanced Troubleshooting (Adult supervision recommended)

**Elenco™ Electronics is not responsible for parts damaged due to incorrect wiring.**

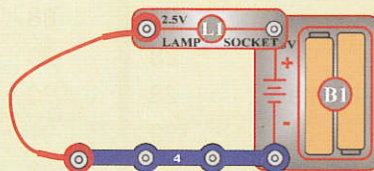
**If you suspect you have damaged parts, you can follow this procedure to systematically determine which ones need replacing:**

1. **2.5V lamp (L1), motor (M1), speaker (SP), and battery holder (B1):** Place batteries in holder and install bulb in lamp socket. Place the 2.5V lamp directly across the battery holder, it should light. Do the same with the motor (motor + to battery +), it should spin to the right at high speed. "Tap" the speaker across the battery holder contacts, you should hear static as it touches. If none work then replace your batteries and repeat, if still bad then the battery holder is damaged.

2. **Jumper wires:** Use this mini-circuit to test each jumper wire, the lamp should light.



3. **Snap wires:** Use this mini-circuit to test each of the snap wires, one at a time. The lamp should light.



4. **Slide switch (S1) and Press switch (S2):** Build project 1, if the lamp (L1) doesn't light then the slide switch is bad. Replace the slide switch with the press switch to test it.
5. **100Ω resistor (R1) and LED (D1):** Build project 7 except initially use the speaker (SP) in place of the LED, you will hear static if the resistor is good. Then replace the speaker with the LED and see that it lights.

6. **Alarm IC (U2):** Build project 17, you should hear a siren. Then place a 3-snap wire between grid locations A1 and C1, the sound is different. Then move the 3-snap from A1-C1 to A3-C3 to hear a 3rd sound.
7. **Music IC (U1):** Build project 74 but use the press switch (S2) in place of the photoresistor (RP). Turn it on and the LED (D1) flickers for a while and stops, it resumes if you press and hold down the press switch. Then touch a 3-snap wire across base grid points A1 and C1 and the flickering resumes for a while.
8. **Space war IC (U3) and photoresistor (RP):** Build project 19, both switches (S1 and S2) should change the sound. Then replace either switch with the photoresistor, waving your hand over it should change the sound.
9. **Whistle chip (WC):** Build project 61 and if there is light on the photoresistor (RP) then you will hear sound from the whistle chip.

**Note:** If you have the more advanced models SC-300, SC-500, or SC-750, there are additional tests in your other project manual(s).

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## Project Listings

Project #	Description	Page #	Project #	Description	Page #	Project #	Description	Page #
1	Electric Light & Switch	8	35	Motor Space Light	20	69	Space War Siren	34
2	DC Motor & Switch	8	36	Space Battle (II)	21	70	Quiet Water Alarm	34
3	Sound Activated Switch	9	37	Silent Space Battle	21	71	Light-Controlled Lamp	35
4	Adjusting Sound Level	9	38	Periodic Sounds	21	72	Voice-Controlled Lamp	35
5	Lamp & Fan in Series	10	39	Blinking Double Flashlight	21	73	Motor-Controlled Lamp	35
6	Lamp & Fan in Parallel	10	40	Motor-Controlled Sounds	22	74	Light-Controlled LED	36
7	Light Emitting Diode	11	41	More Motor Sounds	22	75	Sound-Controlled Time Delay LED	36
8	One Direction for LED	11	42	More Motor Sounds (II)	22	76	Motor-Controlled Time Delay LED	36
9	Conduction Detector	12	43	More Motor Sounds (III)	22	77	Space War Flicker LED	37
10	Space War Alarm Combo	12	44	More Motor Sounds (IV)	22	78	Music AND Gate	37
11	Flying Saucer	13	45	Light-Controlled Flicker	23	79	Flash and Tone	37
12	Decreasing Saucer Lift	13	46	More Sound Effects	23	80	Lamp, Speaker & Fan in Parallel	38
13	Two-Speed Fan	14	47	This OR That	24	81	Pencil Alarm	38
14	The Fuse	14	48	This AND That	24	82	Pencil Alarm Variants	38
15	Musical Doorbell	15	49	Neither This NOR That	25	83	Fun with the Alarm IC	39
16	Momentary Alarm	15	50	NOT This AND That	25	84	Motor Sounds Combo	39
17	Alarm Circuit	16	51	Reflection Detector	26	85	Motor Sounds Combo (II)	39
18	Laser Gun	16	52	Quieter Reflection Detector	26	86	Music Alarm Combo	40
19	Space War	17	53	Flashing Laser Light with Sound	27	87	Bomb Sound	40
20	Light Switch	17	54	Space War Flicker	27	88	Bomb Sound (II)	40
21	Paper Space War	17	55	Spinning Rings	28	89	Light-Controlled LED (II)	41
22	Light Police Siren	18	56	Strobe the House Lights	28	90	Touch Light	41
23	More Loud Sounds	18	57	Race Game	29	91	Touch Sound	41
24	More Loud Sounds (II)	18	58	Using Parts as Conductors	29	92	Water Space War	42
25	More Loud Sounds (III)	18	59	Spin Draw	30	93	Water Space War (II)	42
26	More Loud Sounds (IV)	18	60	Space War Flicker Motor	30	94	Human Space War	42
27	Clap Sounds	19	61	Light-Controlled Sounds	31	95	Noisier Water Space War	43
28	More Clap Sounds	19	62	Light-Controlled Sounds (II)	31	96	Light/Water Space War	43
29	More Clap Sounds (II)	19	63	Light-Controlled Sounds (III)	31	97	OR/AND Space War Light	43
30	More Clap Sounds (III)	19	64	Light-Controlled Sounds (IV)	31	98	Simple Water Alarm	44
31	More Clap Sounds (IV)	19	65	Light-Controlled Sounds (V)	31	99	Simple Salt Water Alarm	44
32	Voice Light Diode	20	66	Electronic Bombing Game	32	100	Ambulance Water Alarm	44
33	Voice Control	20	67	Quiet Zone Game	33	101	Ambulance Contact Alarm	44
34	Motor Space Sounds	20	68	Space War Music Combo	33			

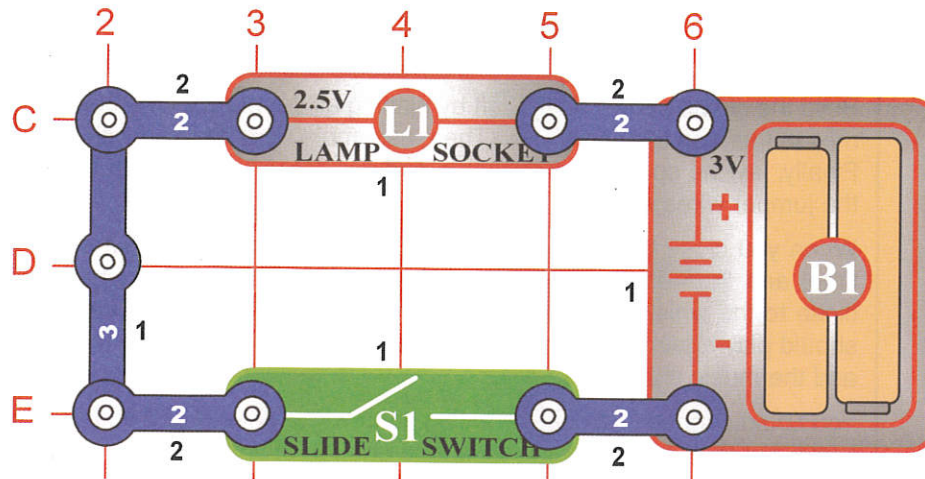




## Project #1

## Electric Light & Switch

**OBJECTIVE:** To show how electricity is turned “ON” or “OFF” with a switch.



Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2. Install two (2) “AA” batteries (not included) into the battery holder (B1) and screw the bulb into the lamp socket (L1) if you have not done so already.

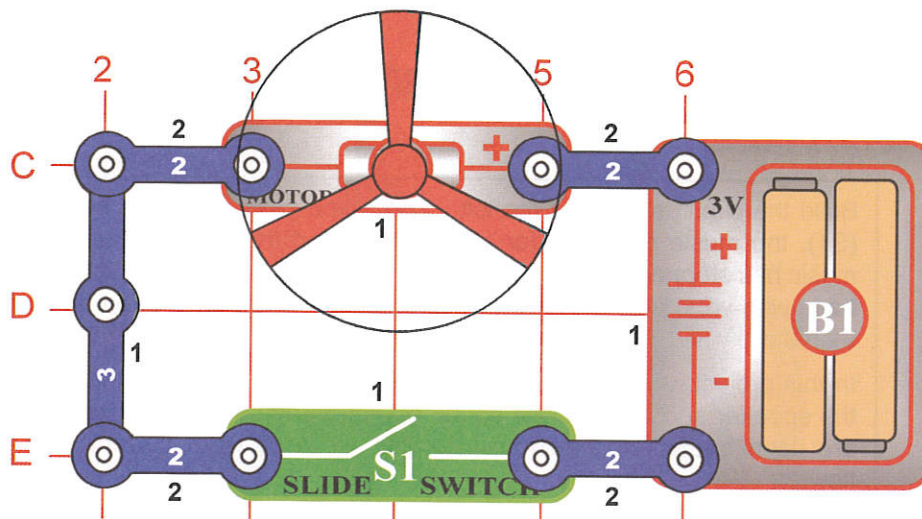
When you close the slide switch (S1), current flows from the batteries through the lamp and back to the battery through the switch. The closed switch completes the circuit. In electronics this is called a closed circuit. When the switch is opened, the current can no longer flow back to the battery, so the lamp goes out. In electronics this is called an open circuit.



## Project #2

## DC Motor & Switch

**OBJECTIVE:** To show how electricity is used to run a Direct Current (DC) Motor.



Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2.

When you close the switch (S1), current flows from the batteries through the motor making it rotate. Place the fan blade on the motor shaft and close the slide switch (S1). The motor will rotate forcing the fan blade to move air past the motor.

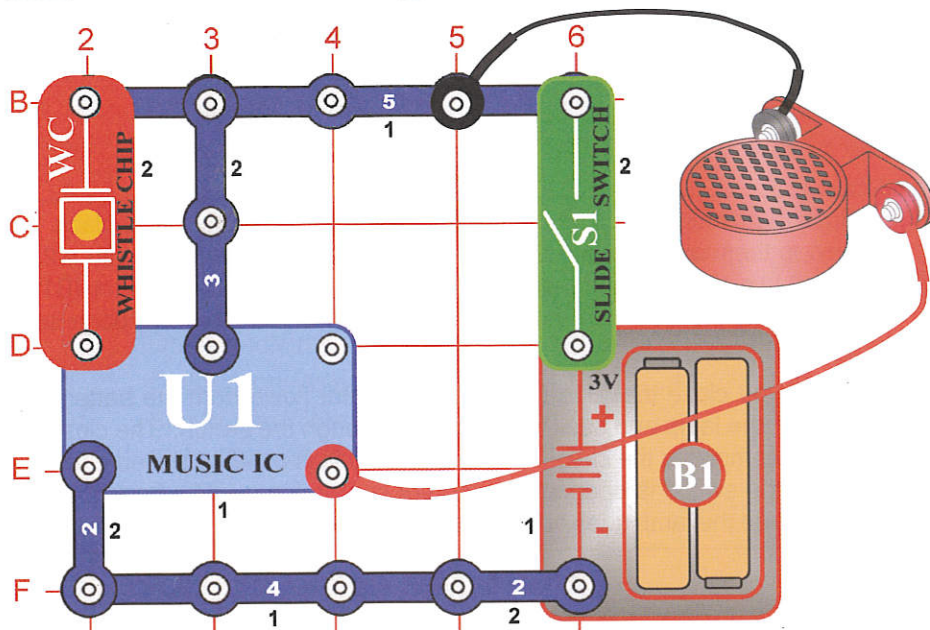
In this project, you changed electrical power into mechanical power. DC motors are used in all the battery powered equipment requiring rotary motion, such as a cordless drill, electric tooth brush, and toy trains that run on batteries just to name a few. An electric motor is much easier to control than gas or diesel engines.



**WARNING:** Moving parts. Do not touch the fan or motor during operation.



## Project #3



## Sound Activated Switch

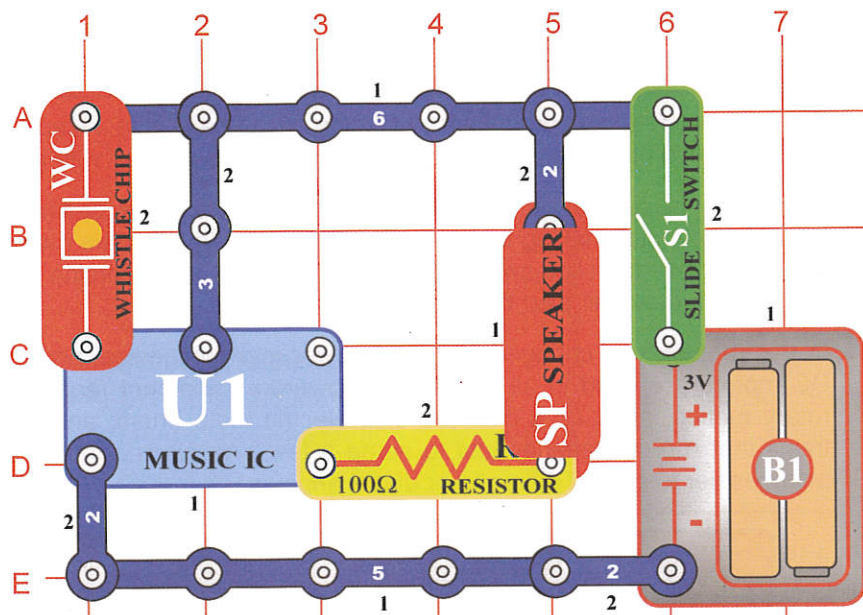
**OBJECTIVE:** To show how sound can turn "ON" an electronic device.

Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2. Finally, lay the speaker on the table and connect it to the circuit using the jumper wires as shown.

When you close the slide switch (S1), the music may play for a short time, and then stop. After the music has stopped, clap your hands close to the whistle chip or tap the base with your finger. The music should play again for a short time, then stop. Blow on the whistle chip and the music should play.

You could connect the speaker using snap wires instead of the jumper wires, but then the speaker may create enough sound vibrations to re-activate the whistle chip.

## Project #4



## Adjusting Sound Level

**OBJECTIVE:** To show how resistance can lower the sound from the speaker.

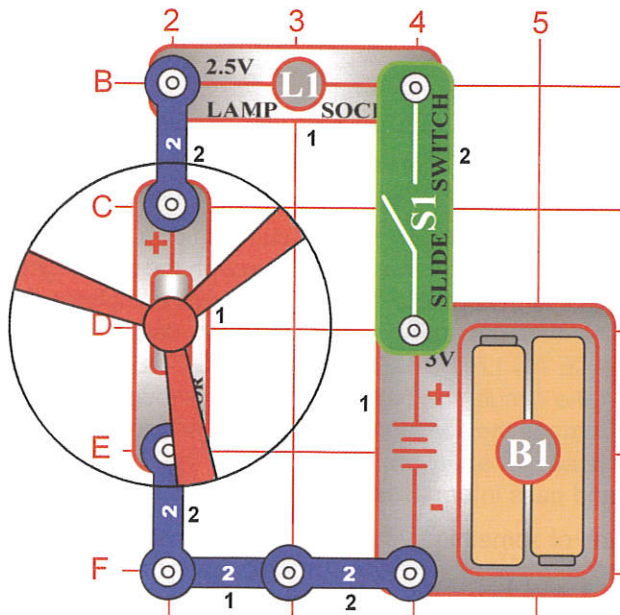
Build the circuit shown on the left. When you close the slide switch (S1), the music may play for a short time and then stop. After the music has stopped, clap your hands close to the whistle chip or tap the base with your finger. The music should play again for a short time, then stop.

In this project, you changed the amount of current that goes through the speaker and reduced the sound output of the speaker. Resistors are used throughout electronics to limit the amount of current that flows.





## Project #5



## Lamp & Fan in Series

**OBJECTIVE:** To show how a lamp can indicate when a fan is running.

Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2. Finally, place the fan blade on the motor.

When you close the slide switch (S1), the fan will spin and the light should turn on. The fan will take a while to start turning due to inertia. Inertia is the property that tries to keep a body at rest from moving and tries to keep a moving object from stopping.

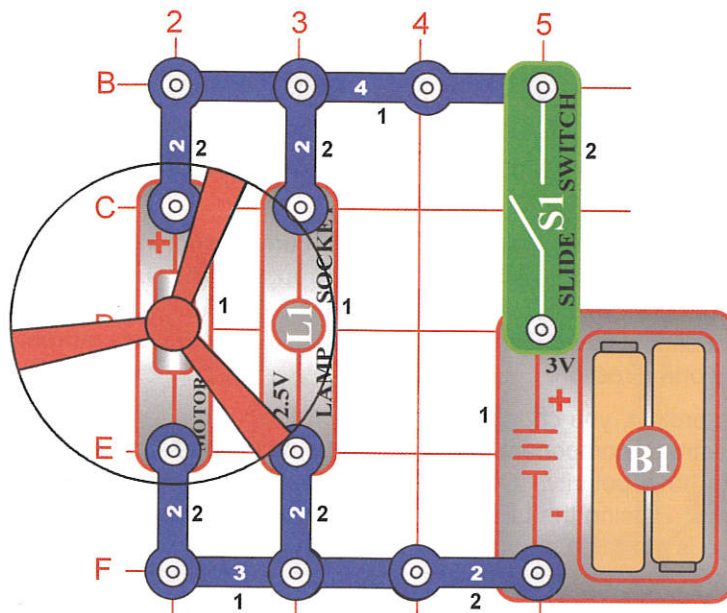
The light helps protect the motor from getting the full voltage when the switch is closed. Part of the voltage goes across the light and the rest goes across the motor. Remove the fan and notice how the light gets dimmer when the motor does not have to spin the fan blade.



**WARNING:** Moving parts. Do not touch the fan or motor during operation.



## Project #6



## Lamp & Fan in Parallel

**OBJECTIVE:** To show how an indicator light can be connected without affecting the current in the motor.

Build the circuit shown on the left.

When you close the slide switch (S1), both the fan and the light should turn on. The fan will take a while to start turning due to inertia. In this connection, the lamp does not change the current to the motor. The motor should start a little faster than in Project #5.

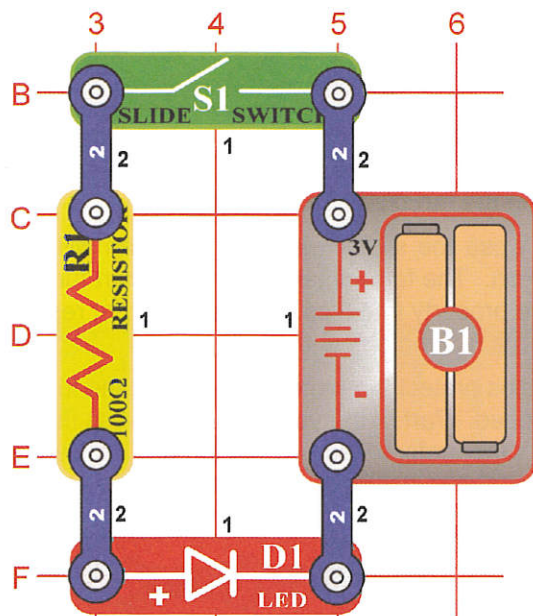
Remove the fan and notice how the light does not change in brightness as the motor picks up speed. It has its own path to the battery.



**WARNING:** Moving parts. Do not touch the fan or motor during operation.



## Project #7



## Light Emitting Diode

**OBJECTIVE:** To show how a resistor and LED are wired to emit light.

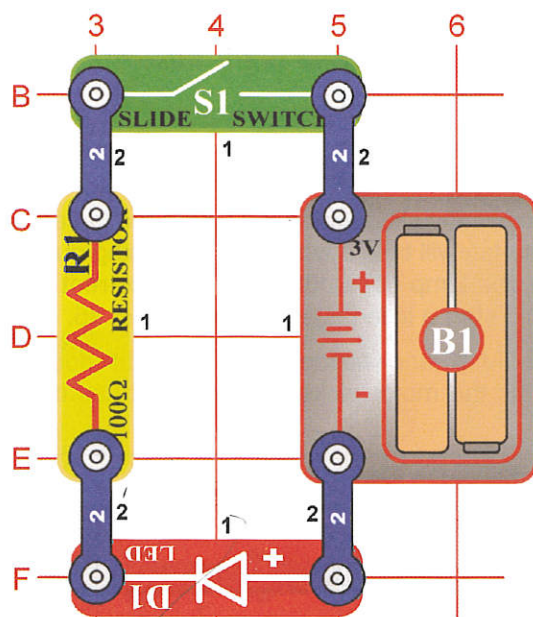
Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2.

When you close the slide switch (S1), current flows from the batteries through the switch, through the resistor, through the LED (light emitting diode) and back to the battery. The closed switch completes the circuit. The resistor limits the current and prevents damage to the LED. **NEVER PLACE AN LED DIRECTLY ACROSS THE BATTERY!** If no resistor is in the circuit, the battery may push enough current through the LED to damage the semiconductor that is used to produce the light. LEDs are used in all types of electronic equipment to indicate conditions and pass information to the user of that equipment.

Can you think of something you use everyday that has an LED in it?



## Project #8



## One Direction for LED

**OBJECTIVE:** To show how electricity can only pass in one direction through an LED.

Rebuild the circuit used in Project #7 but put the LED in as shown on the left.

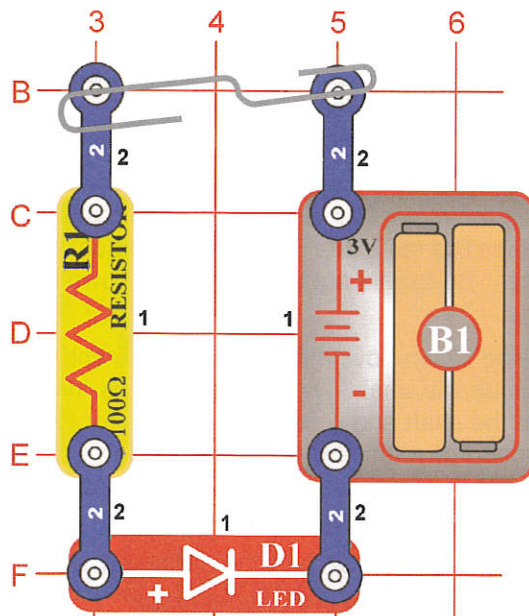
When you close the slide switch (S1), current should flow from the batteries through the resistor and then through the LED. When current flows through an LED, it lights up. Since the LED is in backwards, current cannot flow. The LED is like a check valve that lets current flow in only one direction.

In this project, you changed the direction for current through the LED. An electronic component that needs to be connected in one direction is said to have polarity. Other parts like this will be discussed in future projects. Placing the LED in backwards does not harm it because the voltage is not large enough to break down this electronic component.





## Project #9



## Conduction Detector

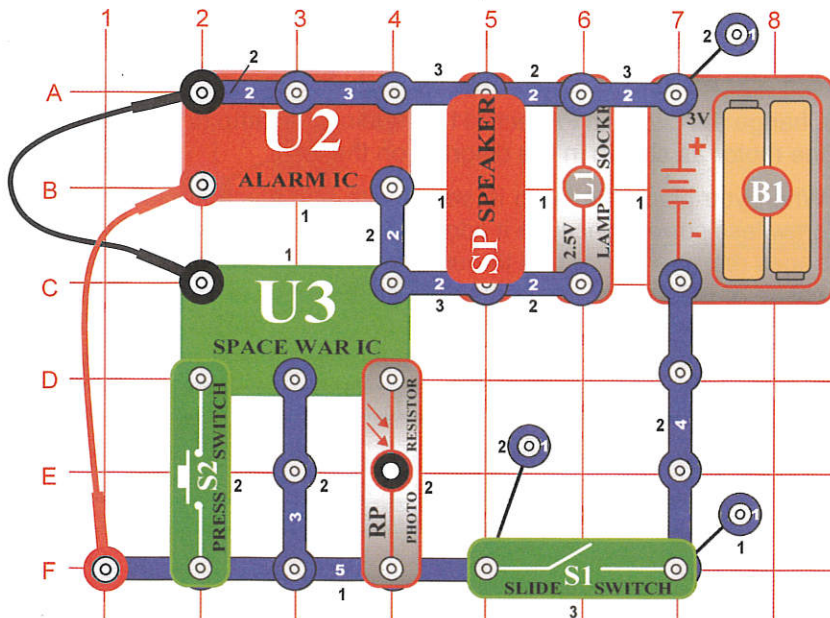
**OBJECTIVE:** To make a circuit that detects the conduction of electricity in different materials.

Rebuild the circuit from Project #7 but leave the on-off switch out as shown on the left.

When you place a paper clip across the terminals as shown in the picture on the left, current flows from the batteries through the resistor, through the LED, and back to the battery. The paper clip completes the circuit and current flows through the LED. Place your fingers across the terminals and the LED does not light. Your body is too high of a resistance to allow enough current to flow to light the LED. If the voltage, which is electrical pressure, was higher, current could be pushed through your fingers and the LED would light. This detector can be used to see if a material like plastic is a good conductor or a poor conductor.



## Project #10



## Space War Alarm Combo

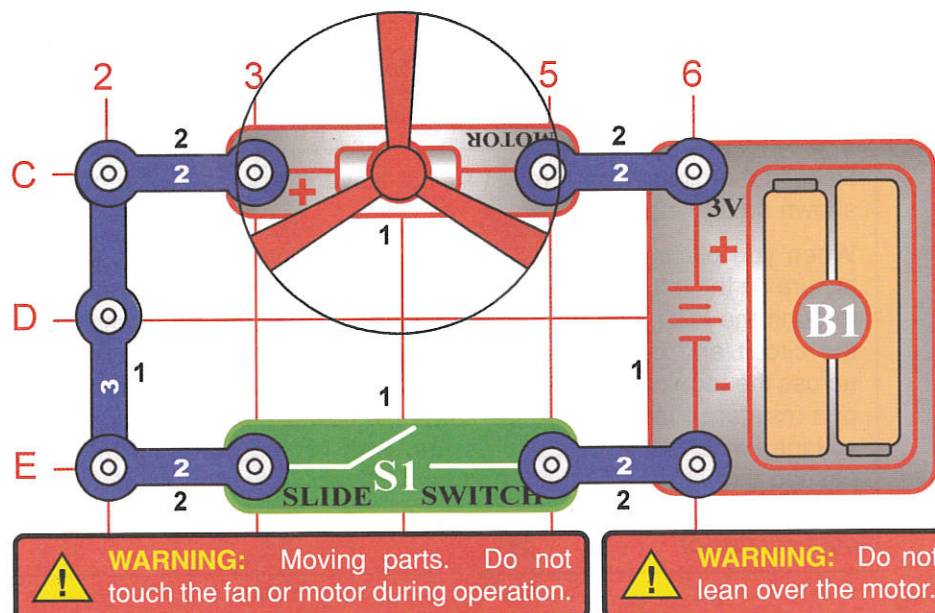
**OBJECTIVE:** To combine the sounds from the space war and alarm integrated circuits.

Build the circuit shown and add the jumpers to complete it. Turn it on, press the press switch (S2) several times, and wave your hand over the photoresistor (RP) to hear all the sound combinations. If the sound is too loud you may replace the speaker (SP) with the whistle chip (WC).





## Project #11



## Flying Saucer

**OBJECTIVE:** To make a circuit that launches the fan blade to simulate a flying saucer.

Rebuild the circuit from Project #2, but reverse the polarity on the motor so the negative (-) on the motor goes to the positive (+) on the battery.

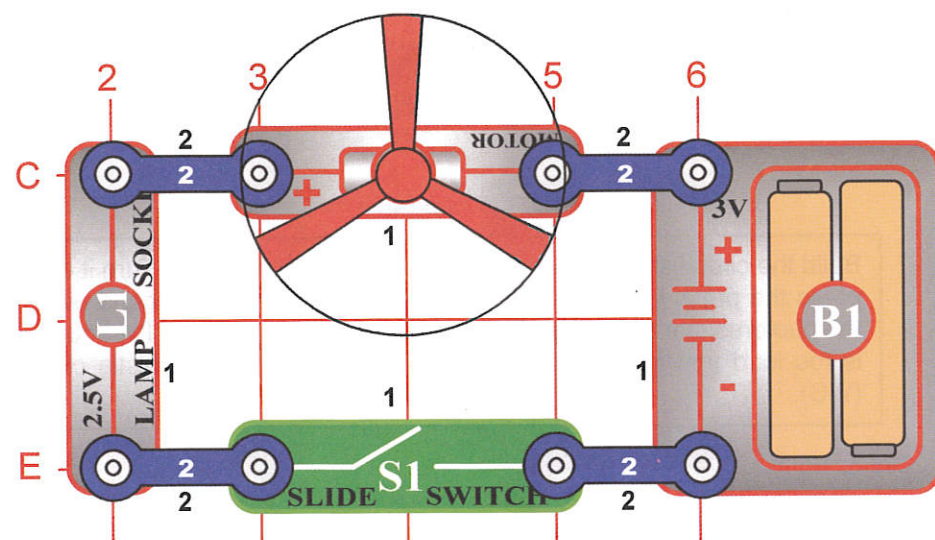
When you close the slide switch (S1), the motor will slowly increase in speed. When the motor has reached maximum rotation, turn the slide switch (S1) off. The fan blade should rise and float through the air like a flying saucer. Be careful not to look directly down on fan blade when it is spinning.

The air is being blown down through the blade and the motor rotation locks the fan on the shaft. When the motor is turned off, the blade unlocks from the shaft and is free to act as a propeller and fly through the air. If speed of rotation is too slow, the fan will remain on motor shaft because it does not have enough lift to propel it. The motor will spin faster when both batteries are new.

If the fan doesn't fly off, then turn the switch on and off several times rapidly when it is at full speed.



## Project #12



## Decreasing Saucer Lift

**OBJECTIVE:** To show how voltage affects speed of a DC motor and can decrease the lift of the saucer.

Change the circuit in Project #11 by adding the lamp (L1) in series with the motor as shown in the diagram on the left.

When you place the lamp in series with any electronic device, it will draw less current because it adds resistance. In this case, the lamp in series reduces the current through the motor, and that reduces the top speed of the motor. Close the slide switch (S1), and wait until the fan reaches maximum speed. Open the switch and observe the difference in the height due to the lamp. In most cases, it may not even launch.



**WARNING:** Moving parts. Do not touch the fan or motor during operation.

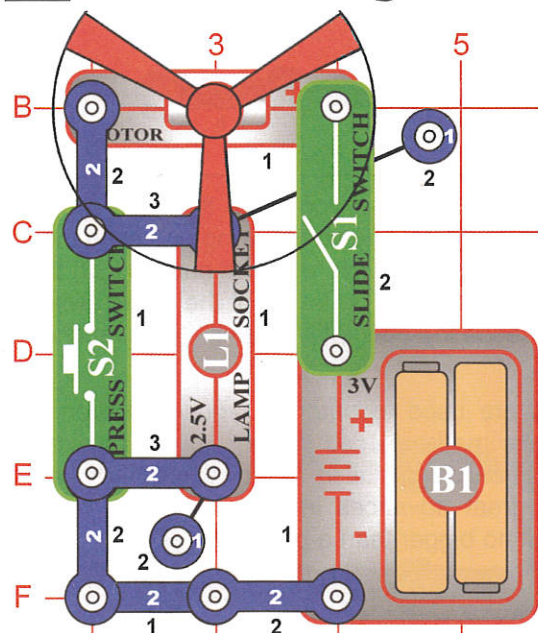


**WARNING:** Do not lean over the motor.





## Project #13



**WARNING:** Moving parts. Do not touch the fan or motor during operation.

## Two-Speed Fan

**OBJECTIVE:** To show how switches can increase or decrease the speed of an electric fan.

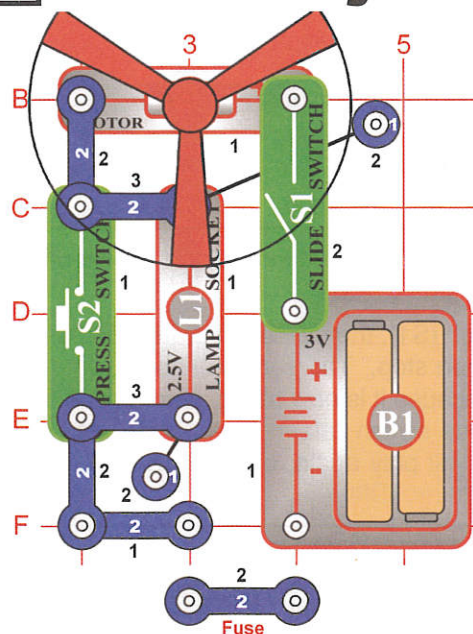
Build the circuit shown on the left by placing all the parts with a black 1 next to them on the board first. Then, assemble parts marked with a 2. Finally, add the 2-snap wires that are marked for level three.

When you close the slide switch (S1), current flows from the batteries through the slide switch (S1), motor (M1), the lamp (L1), and back to the battery (B1). When the press switch (S2) is closed, the lamp is shorted and motor speed increases.

The principle of removing resistance to increase motor speeds is only one way of changing the speed of the motor. Commercial fans do not use this method because it would produce heat in the resistor and fans are used to cool circuits by moving air over them. Commercial fans change the amount of voltage that is applied to the motor using a transformer or other electronic device.



## Project #14



**WARNING:** Moving parts. Do not touch the fan or motor during operation.

## The Fuse

**OBJECTIVE:** To show how a fuse is used to break all current paths back to the voltage source.

Use the circuit built in Project #13.

When you close the slide switch (S1), current flows from the batteries through the slide switch (S1), the lamp (L1), motor (M1), and back to the battery (B1). Pretend the 2-snap wire marked fuse in the drawing on the left is a device that will open the circuit if too much current is taken from the battery. When press switch (S2) is closed, the light is shorted and motor speed increases due to an increase in current to the motor. While still holding press switch (S2) down, remove the 2-snap wire marked fuse and notice how everything stops. Until the fuse is replaced, the open circuit path protects the electronic parts. If fuses did not exist, many parts could get hot and even start fires. Replace the 2-snap wire and the circuit should return to normal.

Many electronic products in your home have a fuse that will open when too much current is drawn. Can you name some?